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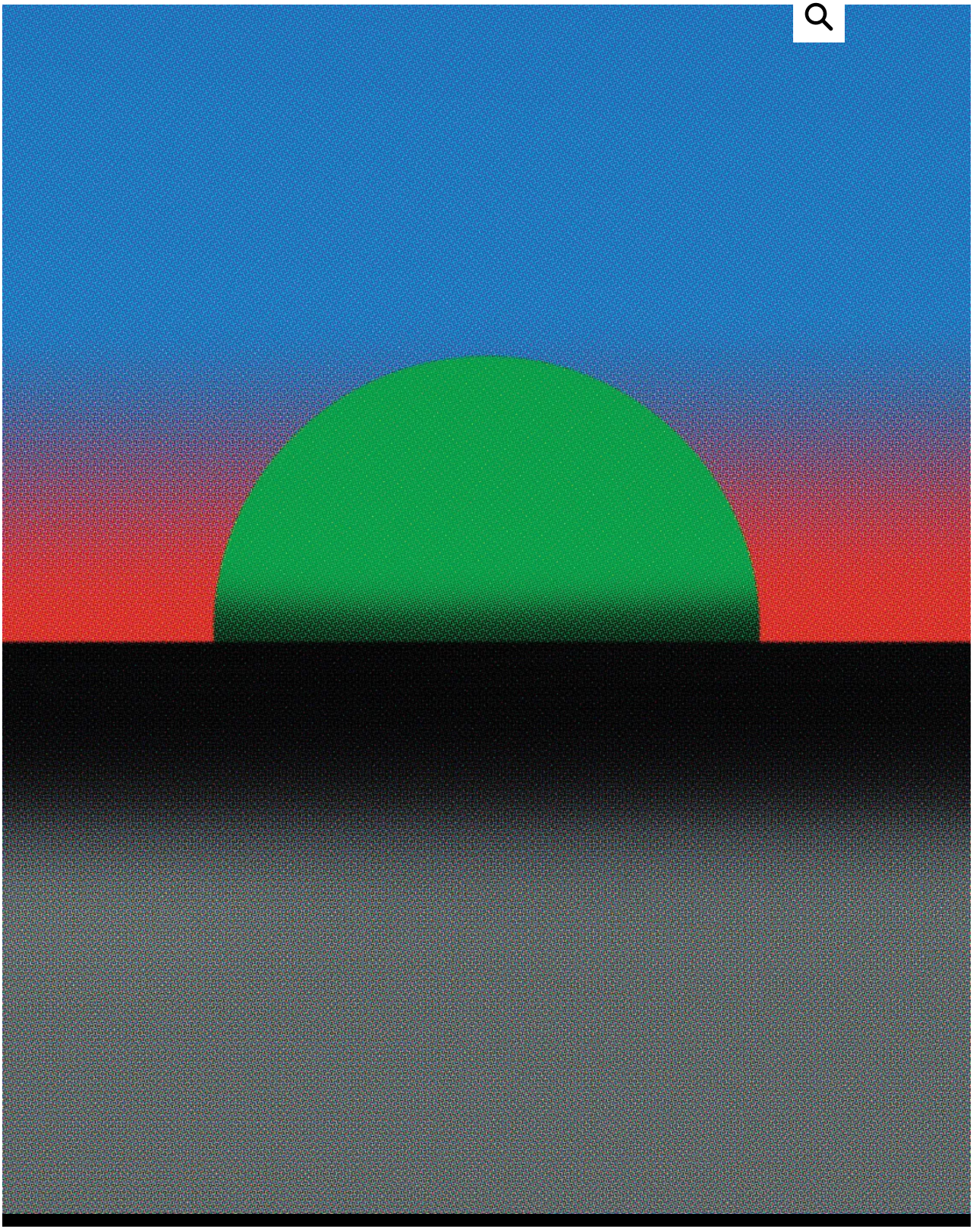

**LIFE AFTER WARMING** | JAN. 19, 2021

# **After Alarmism** The war on climate denial has been won. And that's not the only good news.

*By David Wallace-Wells*

Illustration: Adam Maida

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**In the American Southwest,** birds fell dead from the sky by the tens of thousands, succumbing mid-flight to starvation, emaciated by climate change.

Across the horn of Africa swarmed 200 billion locusts, 25 for every human on earth, darkening the sky in clouds as big as whole cities, descending on cropland and chewing through as much food as tens of millions of people eat in a day, eventually dying in such agglomerating mounds they stopped trains in their tracks — all told, 8,000 times as many locusts as could be expected in the absence of warming.

The fires, you know. Or do you? In California in 2020, twice as much land burned as had ever burned before in any year in the modern history of the state — five of the six biggest fires ever recorded. In Siberia, "zombie fires" smoldered anomalously all through the Arctic winter; in Brazil, a quarter of the Pantanal, the world's largest wetland, was incinerated; in Australia, flames took the lives of 3 billion animals.

All year, a planet transformed by the burning of carbon discharged what would have once been called portents of apocalypse. The people of that planet, as a whole, didn't take much notice — distracted by the pandemic and trained, both by the accumulating toll of recent disasters and the ever-rising volume of climate alarm, to see what might once have looked like brutal ruptures in lived reality instead as logical developments in a known pattern. Our time has been so stuffed with disasters that it was hard to see the arrival of perhaps the unlikeliest prophecy of all: that the plague year may have marked, for climate change, a turning point, and for the better.

**When trying to** share good news about climate, it pays to be cautious, since so many have looked foolish playing Pollyanna. A turning point isn't an endgame, or a victory, or a cessation of the need to struggle — for speedier decarbonization, for a sturdier future, for climate justice. Already, a future without profound climate suffering has been almost certainly foreclosed by decades of inaction, which means the burden of managing those impacts equitably will be handed down, generation to generation, into an indefinite and contested climate future.

But if the arrival of Joe Biden in the White House feels like something of a fresh start, well, to a degree it is. The world's most conspicuous climate villain has been deposed, and though Biden was hardly the first choice of environmentalists, his victory signals an effective end to the age of denial and the probable beginning of a new era of climate realism, with fights for progress shaped as much by choices as by first principles.

The change is much bigger than the turnover of American leadership. By the time the Biden presidency finds its footing in a vaccinated world, the bounds of climate possibility will have been remade. Just a half-decade ago, it was widely believed that a "business as usual" emissions path would bring the planet four or five degrees of warming — enough to make large parts of Earth effectively uninhabitable. Now, thanks to the rapid death of coal, the revolution in the price of renewable energy, and a global climate politics forged by a generational awakening, the expectation is for about three degrees. Recent pledges could bring us closer to two. All of these projections sketch a hazardous and unequal future, and all are clouded with uncertainties — about the climate system, about technology, about the dexterity and intensity of human response, about how inequitably the most punishing impacts will be distributed. Yet if each half-degree of warming marks an entirely different level of suffering, we appear to have shaved a few of them off our likeliest end stage in not much time at all.

The next half-degrees will be harder to shave off, and the most crucial increment — getting from two degrees to 1.5 — perhaps impossible, dashing the dream of avoiding what was long described as "catastrophic" change. But for a climate alarmist like me, seeing clearly the state of the planet's future now requires a conspicuous kind of double vision, in which a guarded optimism seems perhaps as reasonable as panic. Given how long we've waited to move, what counts now as a best-case outcome remains grim. It also appears, miraculously, within reach.

**In December,** a month after Biden was elected promising to return the U.S. to the Paris agreement, the U.N. celebrated five years since the signing of those accords. They were five of the six hottest on record. (The sixth was 2015, the year the agreement was signed.) They were also the years with the highest levels of carbon output in the history of humanity — with emissions equivalent to what was produced by all human and industrial activity from the speciation of *Homo sapiens* to the start of World War II.

They have also been the five years in which the nations of the world — and cities and regions, individuals and institutions, corporations and central banks — have made the most ambitious pledges of future climate action. Most of them were made in the past 12 months, in the face of the pandemic. Or, perhaps, to some degree, *because* of it — because the pandemic demanded a full-body jolt to the global political economy, provoking much more aggressive government spending, a much more accommodating perspective on debt, and a much greater openness to large-scale actions and investments of the kind that might plausibly reshape the world. And because decarbonization has come to seem, even to those economists and policy-makers blinded for decades to the moral and humanitarian cases for reform, a rational investment. "When I think about climate change," Biden is fond of saying, "the word I think of is *jobs*."

There are two ways of looking at these seemingly contradictory sets of facts. The first is that the distance between what is being done and what needs to be done is only growing. This is the finding of, among others, the U.N.'s comprehensive "Emissions Gap" report, issued in December, which found that staying below two degrees of warming would require a tripling of stated ambitions. To bring the planet in reach of the 1.5-degree target — favored by activists, most scientists, and really anyone reading their work with open eyes — would require a quintupling. It is also the perspective of Greta Thunberg, who has spent the pandemic year castigating global leaders for paying mere lip service to far-off decarbonization targets and who called the E.U.'s new net-zero emissions law "surrender."

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The second is that all of the relevant curves are bending — too slowly but nevertheless in the right direction. The International Energy Agency, a notoriously conservative forecaster, recently called solar power "the cheapest electricity in history" and projected that India will build 86 percent less new coal power capacity than it thought just one year ago. Today, business as usual no longer means a fivefold increase of coal use this century, as was once expected. It means pretty rapid decarbonization, at least by the standards of history, in which hardly any has ever taken place before.

Both of these perspectives are true. The gap is real, and the world risks tumbling into it, subjecting much of the global South to unconscionable punishments all the way down. But in the months since the pandemic wiped climate strikers off the streets, their concerns have seeped into not just public-opinion surveys but parliaments and presidencies, trade deals and the advertising business, finance and insurance — in short, all the citadels presiding over the ancien régime of fossil capital.

This is not exactly a climate revolution; the strikers and their allies didn't win in the way they wanted to, at least not yet. But they did win something. Environmental anxieties haven't toppled neoliberalism. Instead, to an unprecedented degree, they infiltrated it. (Or perhaps they were appropriated by it. It's an open question.) Climate change isn't an issue just for die-hards anymore — it's for normies, sellouts, and anyone with their finger in the wind. It will take time, of course, for voters to see empty rhetoric for what it is, and for consumers to learn to distinguish, say, between the claims of guiltless airline tickets, or between carbon-free foods in the supermarket aisle. Harder still will be sorting through the differences between real corporate commitments like Microsoft's and more evasive ones, like BP's. Already, there is considerable consternation among climate activists that the public doesn't understand the tricky math of "net-zero" on which so many of these commitments have been made—it is not a promise of ending emissions, but of offsetting some amount of them, in the future, with "negative emissions," sometimes called "carbon dioxide removal," though no approach of that kind is ready to go at anything like the necessary scale.

In the political sphere, the uneasy alliance between activists and those in power will be tested, producing new conflicts, or new equilibria, or both. Consider, though, that Varshini Prakash, whose Sunrise Movement gave Biden's primary candidacy an F, later helped write his climate plan along with Alexandria Ocasio-Cortez. Climate expertise has been distributed throughout the incoming administration, as was promised during a campaign that closed, remarkably, with a climate-focused advertising blitz. During the transition, Biden's pick for director of the National Economic Council, Brian Deese, was targeted by the environmental left for his time with BlackRock, but even this purported stooge had been married by Bill McKibben, one of the godfathers of modern climate activism.

Elsewhere in the world, where 85 percent of global emissions are produced, the great infiltration of climate concerns represents what the British environmental writer James Murray has called "an alternative history to 2020" and what the scientist turned journalist Akshat Rathi has declared "a strong sign that climate action is starting to be 'institutionalized' — that is, getting deeply embedded into how the world works." This is not about coronavirus lockdowns producing emissions drops or "nature healing." It is instead about long-standing trajectories in coal use and political salience passing obvious tipping points; promises and posturing by powerful if compromised institutions; and policy progress almost smuggled into place, all over the world, under cover of pandemic night. In the U.S., in the second coronavirus

stimulus, $35 billion in clean-energy spending passed in the Senate 92-6 — an effective down payment, energy researcher Varun Sivaram has estimated, on the innovation spending needed for a full electrification of the country. Did you even notice?

Biden's climate plan now faces the challenge of a filibuster, a skeptical Supreme Court, and the mood of Senator Joe Manchin of West Virginia, which means American climate action over the next four years is probably more likely to be delivered piecemeal — through appropriations and stimulus, executive action, and regulation — than through a landmark Green New Deal–style piece of legislation. That does limit what can be achieved, but it also means avoiding a protracted battle over climate as a referendum on the identity of the nation. And at least nominally, having been pressured by activists to do so, Biden is promising to multiply the green spending in that recent stimulus by a factor of 60.

The numbers are numbingly large — reminders that in the midst of pandemic turmoil, the rules of state spending have been dramatically revised and perhaps even suspended. Is this global free-spending binge the beginning of a new era or merely a crisis interregnum to be followed by a new new austerity? "We don't know what the recovery packages of COVID are going to be," Christiana Figueres, one of the central architects of the Paris accords, told me this summer. "And honestly, the depth of decarbonization is going to largely depend on the characteristics of those recovery packages more than on anything else, because of their scale. We're already at $12 trillion; we could go up to $20 trillion over the next 18 months. We have never seen — the world has never seen — $20 trillion go into the economy over such a short period of time. That is going to determine the logic, the structures, and certainly the carbon intensity of the global economy at least for a decade, if not more."

For those dreaming of a climate recovery, the first round of spending was not so encouraging. The E.U. was the gold standard, promising that 30 percent of its stimulus would be earmarked for climate. The U.S. and China each pledged only a fraction of that (and in each case, there was fossil stimulus, too). But in October, a team of researchers including Joeri Rogelj of the Imperial College of London calculated that just one-tenth of the COVID-19 stimulus spending already committed around the world, directed toward decarbonization during each of the next five years, would be sufficient to deliver the goals of the Paris agreement and stop global warming well below two degrees. That analysis may be a touch optimistic, but the level of spending seems, now, doable.

**When Donald Trump** was elected, trashing Paris, climate hawks were left hoping that the world would hang on for the length of his administration — insisting that, in the long term, the crisis couldn't be solved without America at the helm. But the past four years of missing leadership have produced astonishing gains.

The price of solar energy has fallen ninefold over the past decade, as has the price of lithium batteries, critical to the growth of electric cars. The costs of utility-scale batteries, which could solve the "intermittency" (i.e., cloudy day) problem of renewables and help power whole cities in relatively short order, have fallen 70 percent since just 2015. Wind power is 40 percent cheaper than it was a decade ago, with offshore wind experiencing an even steeper decline. Overall, renewable energy is less expensive than dirty energy almost everywhere on the planet, and in many places it is simply cheaper to build new renewable capacity than to continue running the old fossil-fuel infrastructure. Oil demand and carbon emissions may both have peaked this year. Eighty percent of coal plants planned in Asia's developing

countries have been shelved.

This summer, I heard the Australian scientist and entrepreneur Saul Griffith talk about what it would take to get the U.S. within range of a 1.5 degree world. He said it would mean that beginning in 2021, this year,

every single person buying a new car would have to be buying an electric one. *That seems unrealistic,* I thought, making a note of it as a useful benchmark illustrating just how far we have to go.

Then, in the fall, the U.K. pledged to ban nonelectrics by 2030—a once-unthinkable law coming both too slow and much more quickly than seemed possible not very long ago. Similar plans are now in place in 16 other countries, plus Massachusetts and California. Canada recently raised its tax on carbon sixfold. Italy cut its power-sector emissions 65 percent between 2012 and 2019, and Denmark is now aiming to reduce its overall emissions 70 percent by 2030. "We set ourselves challenges that on paper looked almost impossible," the country's minister for the environment, Dan Jørgensen, told me recently. "And I think experts in many countries said, when looking at Denmark, 'This is going to be too expensive, this is going to lower their living standards, this is going to hurt their ability to compete.' But actually I'm proud to say that the opposite has happened. Now, of course, we have set even higher standards."

In the midst of the pandemic, new net-zero pledges, far more ambitious than those offered at Paris, were independently made by Japan, South Korea, the E.U., and, most significant, China, the world's biggest emitter, which promised to reach an emissions peak by 2030 and get all the way to zero by 2060. China's promise is so ambitious it has inspired one wave of debate among experts about whether it is even feasible — given that it would require, for instance, roughly twice as much renewable power to be installed every year for the next decade as Germany has operating nationwide today — and another debate about whether it has revived the possibility of that 1.5-degree target, with economic historian Adam Tooze writing, just after Xi Jinping's surprise announcement in September, that it single-handedly "redefined the future prospects for humanity." Together, the new net-zero pledges may have subtracted a full half-degree from ultimate warming. Add Biden's campaign pledge of net zero by 2050, and you've got about two-thirds of global emissions at least nominally committed to firm, aggressive timelines to zero.

These are all just paper promises, of course, and the history of climate action is littered with the receipts of similar ones uncashed. Plot the growth of carbon concentration in the atmosphere against the sequence of climate-action conferences and a distressing pattern emerges: the World Meteorological Conference of 1979, the U.N. framework of 1992, the Kyoto protocol of 1997, the Copenhagen accord of 2009, and the 2015 Paris accords, all tracking an uninterrupted trajectory upward for carbon from a "safe" level under 350 parts per million, past 400, to 414 today, and pointing upward from there. Before the industrial revolution, humans had never known an atmosphere with even 300 parts per million. Inevitably now, within a few years, the concentration will reach levels not seen since 3.3 million years ago, when sea levels were 60 feet higher. And for all their momentum, renewables still only make up 10 percent of global electricity production.

But alarmists have to take the good news where they find it. And while mood affiliation is not always the best guide to the state of the world, in 2020, for me, there were three main sources of hope.

The first is the fact that the age of climate denial is over, thanks to extreme weather and the march of science and the historic labor of activists — climate strikers, Sunrise, Extinction Rebellion — whose

success in raising alarm may have been so sudden that they brought an end to the age of climate Jeremiahs as well. Their voices now echo in some unlikely places. Exxon was booted from the Dow Jones industrial average within months of Tesla making Elon Musk the world's richest man. The cultural cachet of oil companies is quickly approaching that of tobacco companies. Jair Bolsonaro of Brazil aside, practically every leader of every country and every major figure in every corporate and industrial sector now feels obligated — because of protest and social pressure, economic realities, and cultural expectation — to at least make a show of support for climate action. It would be nice not to have to count that as progress, but it is. The questions are: How much does it matter? And what will follow? Disinformation and human disregard are not the only instruments of delay, and the age of climate denial is likely to yield first not to an age of straightforward climate deliverance but to one characterized by climate hypocrisy, greenwashing, and gaslighting. But those things, ugly and maddening and even criminal as they are, have always been with us. It is the other thing that is new.

The second source of good news is the arrival on the global stage of climate self-interest. By this I don't mean the profiteering logic of BlackRock, which opportunistically announced some half-hearted climate commitments last year, but rather the growing consensus in almost every part of the globe, and at almost every level of society and governance, that the world will be made better through decarbonization. A decade ago, many of the more ruthless capitalists to analyze that project deemed it too expensive to undertake. Today, it suddenly appears almost too good a deal to pass up. (A recent McKinsey report: "Net-Zero Emissions at Net-Zero Cost.")

The logic may be clearest in considering the effects of air pollution, which kills an estimated 9 million people per year. In India, where more than 8 percent of GDP is lost to pollution, poor air quality is also responsible for 350,000 miscarriages and stillbirths every year. Globally, coal kills one person for every thousand people it provides power to, and even in the U.S., with its enviably clean air, total decarbonization would be entirely paid for, Duke's Drew Shindell recently testified before Congress, just through the public-health benefits of cutting out fossil fuels. You don't even have to calculate any of the other returns — more jobs, cheaper energy, new infrastructure. Of course, countries all around the world are incorporating those considerations too, turning the page on a generation of economic analysis that said decarbonization was too costly and its benefits too small to sell to the public as upside.

What is perhaps most striking about all the new climate pledges is not just that they were made in the absence of American leadership but that they were made outside the boundaries of the Paris framework. They are not the result of geopolitical strong-arming or "Kumbaya" consensus. They are, instead, plans arrived at internally, in some cases secretly. This has been eye-opening for the many skeptics who worried for decades about climate's collective-action problem — who warned that because the benefits of

decarbonization were distributed globally while the costs were concentrated locally, nations would move only if all of their peers did too. But a recent paper by Matto Mildenberger and Michaël Aklin suggests this shouldn't be a surprise. In their retrospective analysis, they found that, despite much consternation about designing climate policy to prevent countries from "cheating," there was basically no evidence of any country ever pulling back from mitigation efforts to take a free ride on the good-faith efforts of others. There was, in other words, no collective-action problem on climate after all. For a generation, the argument for climate action was made on a moral basis. That case has only grown stronger. And now there are other powerful, more mercenary arguments to offer.

The third cause for optimism is that, while the timelines to tolerably disruptive climate outcomes have already evaporated, the timelines to the next set of benchmarks is much more forgiving. This is why Glen Peters, the research director at the Cicero Center for International Climate Research, often jokes that while keeping warming below two degrees is very hard, perhaps even impossible, keeping it below 2.5 degrees now looks like a walk in the park.

This isn't to say we're on a glide path to safety. At current emissions levels, the planet will entirely exhaust the carbon budget for 1.5 degrees in just seven years — stay merely level, in other words, and we'll burn through the possibility of a relatively comfortable endgame within the decade. We could buy ourselves a little more time by starting to move quickly, but not that much more. To decarbonize fast enough to give the planet a decent chance of hitting that 1.5-degree target without any negative emissions would require getting all the way to net-zero emissions by around 2035. Simply running the cars and furnaces and fossil-fuel infrastructure that already exists to its expected retirement date would push the world past 1.5 degrees —without a single new gasoline SUV hitting the road, or a single new oil-heated home being built, or a single new coal plant opened.

A two-degree target, by contrast, yields a much longer timeline, requiring the world to achieve net-zero by 2070 or 2080 — without even the help of negative emissions. We'd have to cut carbon production in half in about three decades, rather than one. That pathway will almost certainly prove harder than it looks. The good news is that we seem to be beginning, at least, to try.

**It won't be enough.** It can't be, because we are too far along. There is no solution to global warming, no going back. Achieving a two-degree goal, by rates of decarbonization only dreamed of a decade ago, would deliver a world that looked then quite unforgivably brutal — and should today, too.

Already, the planet is warmer, at just 1.2 degrees, than it has ever been in the long stretch of human civilization, with everything we have ever known as a species — our histories, our agricultures, our cultures, our politics, our geopolitics — the result of climate conditions we have already left behind. It is as

if we have landed on a different planet, with a different climate, and are now trying to determine what aspects of the civilizations we've brought with us can survive these new conditions, what will have to be adapted, and what discarded. The questions raised go beyond political science and into the domain of political philosophy. For some on the left, like Jason Hickel and Julia Steinberger, growth itself is a problem; they've proposed a model of "degrowth," a sort of retreat from consumption by the world's wealthiest 10 percent, who contribute half of all emissions. Economists like Gene Sperling and Joseph Stiglitz want to redefine GDP, or at least make it less synonymous with prosperity, and in New Zealand Prime Minister Jacinda Ardern is trying to design an alternative measure. In the age of Trump and Brexit and Bolsonaro have arisen warnings of incipient "eco-fascism" and what Nils Gilman has described as "avocado politics" — green on the outside, brown pit at the core. Bruno Latour predicted a new age of world war, fought in the name of survival; Andreas Malm called for "war communism in the twenty-first century." Polly Higgins campaigned for a legal regime built around the principle of "ecocide," and Olufemi Taiwo has suggested the only way to avoid an era of climate colonialism is through climate reparations. As the Paris agreement has faded, the fantasy of global climate governance has given way, too, to a raft of alternate proposals: the U.S. and China working together, on the nuclear nonproliferation model; a WTO-style "climate club" enticing participants with trade incentives and punishing latecomers with sanctions; a

style "climate club," enticing participants with trade incentives and punishing latecomers with sanctions, a "G40" to help coordinate and manage the decarbonization of the developing world.

Two degrees is no one's idea of a happy climate outcome — or shouldn't be, I should say. African diplomats have wept at climate conferences at what it would mean for the fate of their continent, calling it "certain death"; island nations have called it "genocide." At two degrees, it's expected that 150 million additional people would die from air pollution, that storms and flooding events that used to hit once a century would hit every year, and that many cities in South Asia and the Middle East that are today home to many millions would become so hot during summer that it often wouldn't be possible to walk around outside without risking death by heatstroke.

"It is a totally different world," Figueres told me. "It's two completely different worlds from the point of view of human misery. It's two completely different worlds from the point of view, certainly, of ecosystem resilience. It is two completely different worlds with respect to economic profitability and stability. And it will be unmanageable for any social system in any country to deal with the increased poverty and the increased migration pressure that a two-degree world will bring."

When I say we are now heading toward a best-case outcome, this is what I mean.

**So what can** we do to get through this very, very difficult time for planet Earth?"

It is early January, and I am speaking with Elizabeth Kolbert, from her home in Massachusetts, about her spellbinding new work of you-broke-it-you-bought-it environmental reportage. As is often the case in exchanges like these, our conversation is built on a presumed baseline of climate disruption. But we are not talking about how bad things will be at two degrees or north of it. We are talking about what will be done, in that new world, to try to secure some semblance of normalcy and possibility — for some, at least. Warming in the global South, Kolbert says, will be "an unmitigated disaster."

*Under a White Sky* is one of several major books on warming being published this winter, presumably timed to the inauguration of a new climate-conscious president. But unlike Michael Mann's *The New Climate War* or Bill Gates's *How to Avoid a Climate Disaster,* it marks a notable turn in perspective for its author. Kolbert is, by temperament and intellectual inclination, a preservationist and a conservationist. Her first two climate books, *The Sixth Extinction* and *Field Notes From a Catastrophe,* were works of explicit lamentation and implicit exhortation. The new book begins from the premise that the world is already past a point of no return: "Humans are producing no-analogue climates, no-analog ecosystems, a whole no-analog future," she writes. The book's key question is: What innovations will we jerry-rig, and what risky interventions will we conscience, as we slide down the precipice? Her ambivalent response is "If there is to be an answer to the problem of control, it's going to be more control."

The word for this in the climate vernacular is *adaptation,* and it has been, for a few decades, a dirty one. Adaptation has traditionally been the favored approach of skeptics, agnostics, and the growth-focused advocates sometimes called "lukewarmers." It has given rise to an entire school of thought

advocates sometimes called "lukewarmers." It has given rise to an entire school of thought, "ecomodernism," conceived to reckon with and plan for future life on a Frankenstein's planet, but has been seen by activists as a dangerous illusion encouraging indifference and apathy. "In the United States and other wealthy countries, efforts to adapt to global warming have always played second fiddle to efforts to reduce carbon emissions," veteran climate scientist Michael Oppenheimer recently wrote. "This emphasis is understandable, since if greenhouse-gas emissions are not restrained, successfully adapting to climate change will be impossible for most of humanity."

The choice, as Oppenheimer suggests, was always false, or at least has been for some time, since the world passed outside the envelope of comfortable climates that have enclosed all of our history. When unprecedented-seeming disasters began arriving in the northern hemisphere with regularity, the logic became clearer to those who had long assumed that their wealth would protect them — and that, therefore, growth alone could protect others. And while recent climate action has apparently lowered the ceiling of possible warming this century, long delays have raised the floor. "Policy-makers no longer have the luxury of downgrading adaptation," Oppenheimer continued, "because climate change's devastating effects are no longer in the future; they are occurring now."

And worsening. If fires in the American West are, in a best-case scenario, going to grow sixfold, Americans living there can't count on a project of decarbonization alone to protect them. If Calcutta will see, at two degrees, a hundred days of lethal heat each year, stabilizing warming at merely that level isn't going to do the trick. "We're used to the Hollywood ending," Kolbert tells me. "Oh, you know, at the last minute, something comes and saves us. That just isn't happening." To her, the course is almost laughably clear. "Adaptation — well, you know, duh, of course, we're going to have to do it. We are doing it."

In her book, Kolbert sketches a spectrum of interventions, from electrifying rivers to using CRISPR to save endangered species to solar geoengineering, often called "solar-radiation management," by which aerosol particles are suspended in the stratosphere to deflect some sunlight back into outer space and artificially cool the planet. "There is a slippery slope here, you know?" she says. "And where does that end? But there are not a lot of great choices. We're not returning to a preindustrial climate — not in my lifetime, not in your lifetime." Perhaps, she allows, over many lifetimes, given a relatively quick carbon exit followed by large-scale negative emissions, the climate that has prevailed for all of human history might conceivably be restored. But the timescales are so long that generations would be spent neck deep in the big muddle, with many drowned along the way. "We are halfway across that river, and we can't get out of it now. We can't," she says. "And why assume that we're going to figure that out? I mean, I think that we have to be radically agnostic about everything. You can't say, 'Well, we figured it out in the past, we're going to figure it out again.' I don't think that's a given by any stretch of the imagination. Emotionally, at least, I don't give us great odds."

Even many "natural solutions" favored by environmentalists, Kolbert says, don't really live up to the name — or represent a true exit ramp from a self-degrading Anthropocene. She mentions building out marshland to help manage river flooding and genetically modifying chestnut trees to repel an insidious fungus. "One big conservation proposal that's out there is E. O. Wilson's 'half-earth' — we should put a half of the planet aside for other species. But even that — which I would certainly support — isn't really conserving the world. That is changing the world. That's not the world that we had."

To this point, the returns on engineered adaptations have been spotty. Advocates point to awe-inspiring flood-management systems in the Netherlands, but the $14 billion levees built in New Orleans after

Katrina don't protect against category-five hurricanes today and, thanks to sea-level rise and ground subsidence, may no longer provide "adequate" protection as soon as 2023. The challenges will grow, in some cases exponentially, but the larger blueprint of adaptation is there for all to see, a photonegative of all of the impacts scientists have told us to expect even over the next few decades: heat stress and sea-level rise, wildfire and river flooding, agricultural decline, economic stagnation, migration crises, conflict, and state collapse.

Much of the most eye-opening work to integrate these has been done by Solomon Hsiang of the Climate Impact Lab; when I mentioned adaptation to him, he laughed. He was all for adaptation, he said, and has focused some recent work on the question of just how we might better respond to climate impacts. But he's also built most of his models on recent history, he said, precisely in order to reflect at least our present-day capacity to adapt. Those models suggest unmitigated warming could cost global GDP more than 20% of its value by the end of the century; limit warming to two degrees and climate change would still kill as many people each year as COVID-19 has. You don't do adaptation on top of that, Hsiang said. Those figures already reflect the adaptation.

In a certain way, a response to sea-level rise is the easiest to conceptualize. Its most dramatic impacts arrive slowly, over centuries, giving generations time to adjust. But the adjustment will have to be very large indeed: Perhaps half the world's coastline will have to be abandoned, according to one climate rule of thumb, the other half protected by defensive infrastructure of a scale straight out of the realm of cyberpunk. The city of Charleston, South Carolina, for instance, recently green-lit a $2 billion seawall proposed by the Army Corps of Engineers, which has also produced a few options for New York Harbor, including a $100 billion barrier that would nevertheless expose much of the city's suburban sprawl. The Army Corps proposal for South Florida doesn't even aim to protect Miami Beach, with flood barriers erected instead on the mainland and the barrier island left, presumably, to fend for itself. This is in the world's richest country. Places like Bangladesh or Myanmar, barring meaningful climate reparations, will likely focus on flood-alarm systems, concrete bunkers, and a goal of managed retreat.

Declines in deaths during heat waves in parts of Europe have shown that there are some possible responses to the problem of heat. (They include more widespread air conditioning and public cooling centers; better public communication and water-drinking campaigns; and reworking the elements of urban infrastructure, like asphalt and black roofs, that amplify dangerous temperatures.) But whether these measures will work as well when extreme heat is seasonal as when it is daily, in much poorer parts of the world, remains to be seen. Farmlands can't be moved all that much, but crops can be genetically edited to thrive in the new world, with aversions to GMO foods becoming either a residue of an earlier era of relative abundance or a luxury of the affluent, or both. Fossil-fuel infrastructure will have to be retired early, and its workforce too, meaning trillions of dollars in stranded assets and perhaps millions of workers stranded, too — maybe a million in the U.S. alone, 20 times as many as work today in the coal industry. This is what climate advocates mean when they talk about managing a "just transition," and, in recent years, they have broached the thorny subject of adaptation through the language of climate justice: Who is protected? Who is exposed? At what cost? And to whom?

In theory, the fossil-fuel business could be functionally replaced by negative-emissions plantations, both industrial and "natural," undoing the whole work of industrialization by recapturing carbon from the sky. But this is not work that can be done out of sight or out of mind. Planting forests at a scale large enough to meaningfully alter the planet's carbon trajectory, for instance, could elevate food prices by 80 percent

meaningfully after the planet's carbon trajectory, for instance, could elevate food prices by 80 percent. Reforestation might require, according to one recent review, land between five and 15 times the size of

Texas. Doing it with machines, the same review found, would require something on the order of a third of today's global energy use. Even in the most optimistic scenario, billions of tons of carbon would have to be removed from the air every year and stored somewhere—and less optimistic scenarios, of course, will require more. At the local, national, and international levels, these projects are likely to provoke NIMBY resistance beyond the ones we've seen over wind and solar farms — though those, of course, will continue too. Decarbonizing America's power sector with renewables, a recent Princeton study suggested, would require 10 percent of the country's continental land — though another research project suggested it could create as many as 25 million jobs. But the fight to build turbines in Nantucket Sound to power much of the deep-blue region took a decade and was ultimately defeated. Today, a major offshore wind project is being blocked by the wealthy homeowners of Wainscott, a hamlet of 349 people in the Hamptons, even though the turbines would be located on the other side of Long Island, entirely out of their view. They just don't want the intrusion of a power cable, which would be installed underground and remain out of sight.

And there will be fights for new resources, too — with demand for the materials in solar panels tripling or more over the next few decades, and the need for battery ingredients like cobalt, lithium, and other rare earths growing so quickly that a renewable-energy transition almost necessitates an explosion of "extractivism," too. That is, mines all around the world opened to disgorge resources at a rate much faster than those that powered the global industrial revolution over centuries, and in ways that invariably generate state conflict, as Thea Riofrancos, among others, has documented.

Living with fire will probably require a root-and-branch rethink of housing policy, at least in California, where millions are already at risk and where 60 percent of new residential housing built since 1990 has been on fire-prone land. During that time, the wildfire threat has grown, by one estimate, 900 percent. On top of that, as Zeke Hausfather and Mark Paul have proposed, perhaps many thousands could be employed in a new Civilian Conservation Corps that could thin the state's forests of brush and manage the "controlled burning" of 20 million California acres — a fifth of the state's land and five times what burned in the catastrophic 2020 season.

And yet, this is the face of the new world. Or it will be, if we're lucky. While adaptation sounds like a technocratic, "just fix it" option, what is required even now seems to approach the scale of terraforming — at least until you remember that 95 percent of the earth's surface has already been remade by human hands. These measures aren't trivial; they aren't a way to avoid hard choices but a last-resort attempt to square the punishing climate we are making with one we may feel comfortable living in, relatively speaking. In the century to come, which will be defined both by ghastly impacts and, one hopes, extraordinary human responses, even conditional success may require as much world-building as world-saving.

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